Thesis/
Reports
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Long-Range Fire Assessment

Great Basin Geographic Area

1998 Fire Season

Final Report

National Interagency Fire Center
Boise, Idaho

July 29, 1998

Executive Summary

The 1998 fire season has not reached full potential at this time due to early season above average moisture in the northern areas, and high July precipitation in southern portions of the Basin. These trends are predicted to change as a high pressure system moves over the Basin in August causing a decrease in mosoonal moisture and significant drying in the north. This situation could lead to typical or above average fire season activity in August, which historic data indicate is the most active time of year. Another factor is that the Basin is supporting significant fine fuel accumulations this year. These fuel loads in combination with a drier than normal August and September could lead to a marked increase in fire activity for the entire Great Basin. National Fire Danger Rating indices also show that seasonal drying is lagging behind the normal trend for most area through the early part of the summer. However, fine fuels are quickly drying to average or drier than average conditions.

Weather patterns across the Great Basin during the 1998 winter and spring were greatly influenced by one of the stronger El Nino events of this century. This resulted in a mild winter with a heavier than normal snowpack in Nevada and Utah and a near to below normal snowpack in central/southern Idaho and western Wyoming. Spring turned wet and unseasonably cool throughout the entire region except for the extreme southern part of Nevada and portions of eastern Utah. Record May rains fell in central and southwestern Idaho. McCall and Idaho City both received over seven inches of rain in May. The cool, wet spring resulted in delaying the normal snowmelt well into June. The additional moisture also produced a much heavier than usual grass crop in the lower elevations.

By early July ocean temperatures in the Equatorial Pacific rapidly cooled signaling an end to El Nino and the beginning of La Nina. La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures from the date line eastward to the South American coast. Long-range forecasts indicate that this La Nina may be one of the stronger events, similar to the 1988-1989 La Nina.

Most of the effect of the developing La Nina will likely occur during the coming winter when it should be at it's greatest strength. The main effect during the remainder of the summer will be a weakening of the normal monsoon moisture over southern Utah and southern Nevada. However, historic records from strong La Ninas in the past suggest a drier than normal fall is possible, delaying the typical end of fire season into late October or early November.

Long range seasonal forecasts for the coming winter indicate drier and milder than normal weather for southern Utah and southern Nevada and wetter and cooler than normal weather from central Nevada and central Utah northward into Idaho.

It is important to remember that we cannot know the future with certainty. The team reviewed historical climate, fire danger, and fire occurrence data and developed three possible scenarios. The best case scenario represents a normal end to the fire season in the Great Basin. Under this scenario, normal weather patterns are expected; initial attack is largely successful with the large fire load near average for the rest of the fire season. Suppression resource demands are largely met from within the geographic area. Under the intermediate scenario, warmer and drier than normal conditions are expected with higher than normal probability of dry lightning. Mid-elevations are more active in this scenario and some resource shortages occur. The fire season extends into the fall consistent with La Nina influences. The worst case scenario represents much warmer and drier than normal weather with only minimal precipitation. Dry

lightning is more likely due to low atmospheric moisture levels. Dry cold fronts are expected with high chances of extended drying periods. All elevations experience large fire activity. This scenario is much like the 1988 fire season. Many large fires, perhaps at record setting levels would develop. Suppression resource demands within and outside the area would be high, possibly impossible to fill. Threats to life and property escalate, fire behavior is extreme, and the season lasts well into the fall.

The most likely scenario for the remainder of the summer is the intermediate scenario, which implies an extended dry fall. The worst case has a higher probability of occurrence than the best case scenario.

Important considerations that will directly influence the remainder of the 1998 fire season in the Great Basin are:

- High fuel loadings carried over from 1997, in addition to above average growth in 1998, pose a potential threat in rangelands.
- Recent cool and moist weather is not expected to continue.
    - The monsoon will be weak in southern Utah and Nevada.
    - High pressure will dominate most of the geographic area with a return to hot and dry conditions.
- The La Nina weather phenomenon will dominate the weather through the fall and into the winter. Historical records indicate that fall rains may be delayed until November in La Nina years.
- High elevation forests in Utah and central Idaho are not at critical moisture levels currently but may become critical with extended drying.
- If fire activity does escalate, it will be at a time when other geographic areas are also in the heart of their fire season with high competition for resources.

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Introduction

The demand for long-range fire assessments has been increasing during the last decade and increased needs for better information to support fire management decision-making will continue to grow (Mutch 1998). Long-range assessments ranging in magnitude have been periodically completed since 1987 in various parts of the United States. These previous examples varied according to desired objectives and specific fire circumstances. Past assessments, although variable in nature, have focused on three principal areas: possible growth of escaped wildland fires, regional fire assessment, and long-duration wildland fire assessment.

Early in the 1998 wildland fire season the State of Florida experienced one of the worst fire seasons in history. Many large fire complexes burning in mixtures of wildland and developed areas resulted in over 450,000 acres burned and an estimated 370 structures damaged or destroyed. As resources were mobilized and assigned from throughout the United States to battle the Florida fires, questions arose regarding the severity of this situation, its potential duration, and continuing resource needs. To respond to these information needs, the National Multi-Agency Coordinating Group (MAC) at the National Interagency Fire Center (NIFC) in Boise established a Long-Range Fire Assessment Team. The team reviewed the fire potential, expectations of future activity, briefed local officials and wrote a formal report.

As time progressed the Florida situation moderated and the National MAC directed that another team be assembled to assess potential fire conditions in three western geographical areas and prepare formal reports: Great Basin, Pacific Northwest, and Northern Rocky Mountains. This is the first of the three reports.

The fire potential situation in the Great Basin warrants an assessment of the regional-scale fire situation. A region-wide assessment, such as the Northern Rockies 1994 Assessment (Bradshaw and Andrews 1998) presents a difficult challenge (Rothermel 1998). The area of concern is large in size and may include many fires. As a result, assessment of long-term risk, fire growth, and fire duration for individual fires does not provide information relative to all fires and circumstances. Often, a large number of individual fires also precludes detailed analysis for each fire. Furthermore, as in this case, an assessment may precede the onset of a severe fire situation. This assessment was designed to focus on comparative differences among current and historical conditions for the geographic area of concern. Analytical techniques utilized included products of the National Fire Danger Rating System (NFDRS) (Deeming, Burgan, and Cohen 1977), review of climatological data, remote sensing of vegetation conditions by satellite, and computer models used by the National Weather Service to predict possible future weather patterns.

The objectives of the long-range fire assessment for the Great Basin area are:

- Review the overall severity of the wildland fire situation in the Great Basin,
- Compare the on-going fire potential with historical situations,
- Evaluate the expected duration and assess the probability of season-slowing and season-ending events,
- Develop implications of the remainder of the fire season in the Great Basin, based on projections of "best-case, intermediate, and worst-case" scenarios.

The team established to complete this assessment consisted of interagency specialists from various areas and having skills and experience in numerous types of fire assessments, projections, and evaluations.

The assessment team consisted of the following individuals:

Mike Hilbruner	USFS - R-6	Team Leader
John Robertson	USFS - Umatilla NF	Fire Behavior Analyst
Chuck Vickery	USFS - Deschutes NF	Fire Behavior Analyst
Lisa Elenz	NPS – Grand Teton NP	Fire Behavior Analyst
Roberta Bartlette	USFS - Intermountain Fire Sciences Lab (Missoula, MT)	Forester
Paul Werth	NWS – Boise, ID	Meteorologist
Larry Bradshaw	USFS - Intermountain Fire Sciences Lab (Missoula, MT)	Meteorologist

Current Situation

Weather:

Large variances in weather are typical across the Great Basin, especially from north to south. However, El Nino amplified differences during the 1998 winter and spring. Unusually warm ocean temperatures in the Equatorial Pacific from the date line eastward to the South American coast characterize El Nino. It occurs in cycles ranging from two to seven years with marked differences in intensity and duration. This El Nino was comparable to the 1982-1983 episode, perhaps the strongest in recorded history. The phenomenon is linked to shifts in global precipitation patterns resulting in floods in arid regions and droughts in areas that are normally wet. Severe droughts and large wildland fires occurred during this El Nino event in Australia, Indonesia, Central America and Africa. In North America, the impacts of El Nino are most pronounced during the winter. The jet stream becomes stronger and sags farther south over the southern United States. Meanwhile, persistent high pressure becomes established over western Canada. The southern states from California to Florida typically experience cool, wet weather during the winter while the northern tier of states are drier and milder than normal. Winter precipitation in the Great Basin reflected this pattern. Snowpacks were below normal (70 to 90 percent) in central/southern Idaho and much above normal (130 percent or more) in Nevada and Utah (Figure 1). Temperatures were unusually mild in the Great Basin this winter. For example, Salt Lake City was 10° F and Reno was 5° F above normal in January.

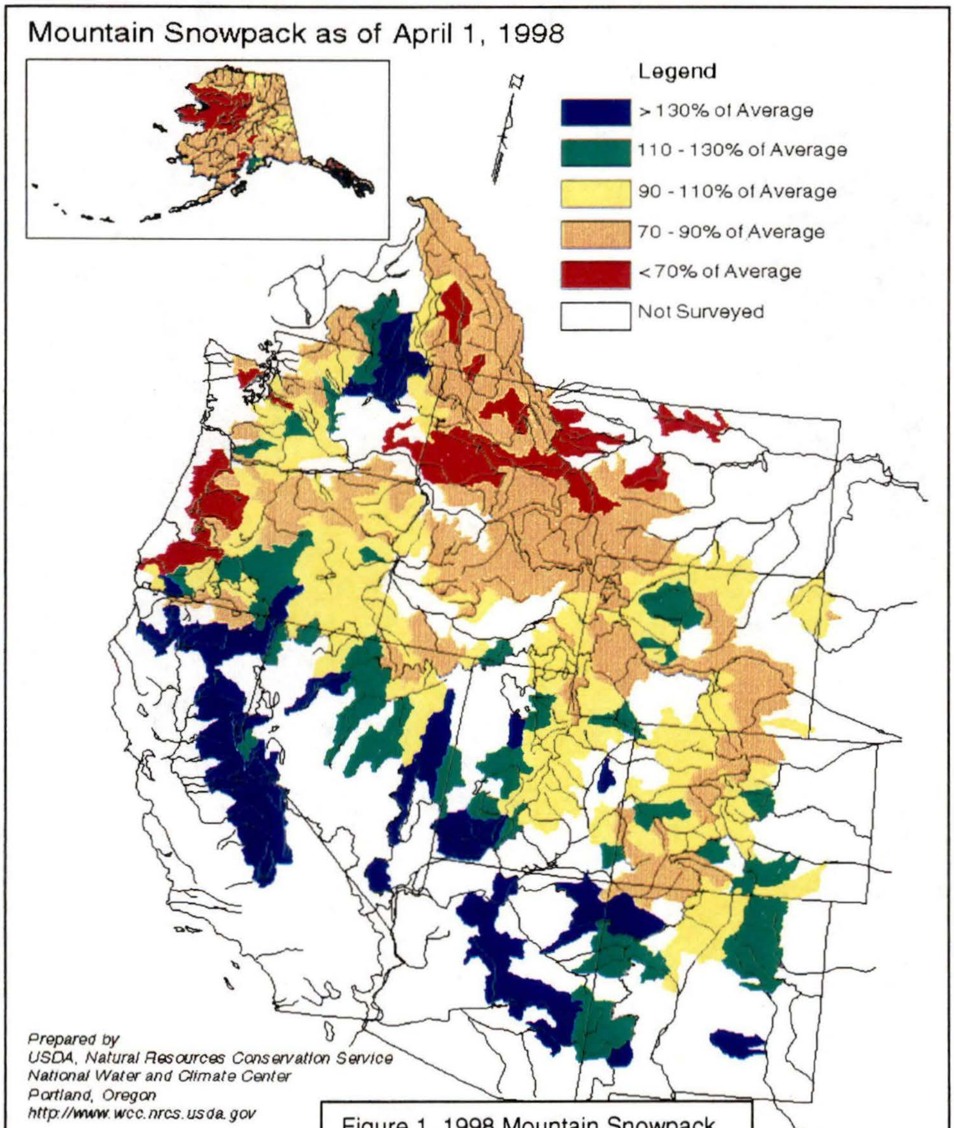


Figure 1. 1998 Mountain Snowpack

Fire Danger and Greenness Imagery:

Measures of fire danger have varied throughout the Great Basin, reflecting both the weather and seasonal trends exhibited to date. While in some areas the Energy Release Components were reaching historic maximums others were below normal. Woody and herbaceous fuel moistures have also ranged from setting maximum records in the northern areas to being at historic minimums in the southern areas. Satellite imagery shows that live fuel moistures have very quickly trended toward normal with the hot/dry weather over the area. Fuel moistures in the southern areas remain below normal at this time. Although Energy Release Components seem to be trending toward normal with the weather changes, fuel moistures continue to be low in areas and near normal in others. These indicators show that as the season progresses in the north, fire potential exists. With the expected decrease in the southern area's monsoonal moisture, fire potential remains high.

The condition of live vegetation can be assessed using the Normalized Difference Vegetation Index (NDVI), calculated from satellite observations at a 1 kilometer resolution. The NDVI relates to the amount of actively photosynthesizing biomass, or vegetation "greenness", and can be interpreted to assess relative fire danger (Burgan and Hartford 1993). The greenness data are displayed as maps. Two maps useful for interpreting vegetation condition to fire potential relate the NDVI of each kilometer to its own historical record. Relative Greenness maps represent how green the vegetation is compared to the range of values observed since 1989 when this data became available. They are useful for showing seasonality vegetation change and for comparing years. Departure from Average maps display differences between current and average greenness for that time of year.

During the past few weeks, most of the Great Basin has reached near or over 100% of the maximum greenness recorded during the period of history. The peak in greenness was reached over all but the Central and Southern Idaho fire weather zones during the composite week of 7/10 to 7/16/98 (Figure 2). Central and Southern Idaho reached their peak greenness, at similar levels, in the previous weeks. Many areas remained at high levels the following week (Figure 3).

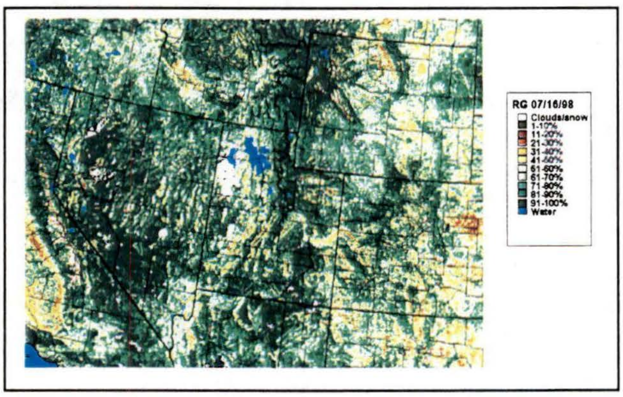


Figure 2. Relative greenness - 7/16/98.

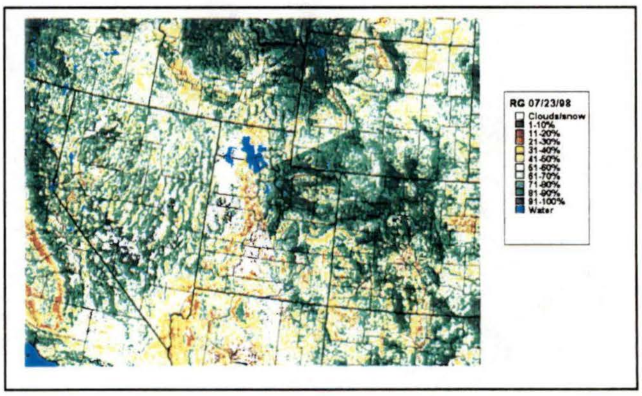


Figure 3. Relative greenness - 7/23/98.

Figure 4 presents the Departure from Average map for the composite period ending 07/23/98. The normal condition for this time of year for most herbaceous plants is matured or curing. The majority of the area ranged from 125% to 145% of average greenness for that time period.

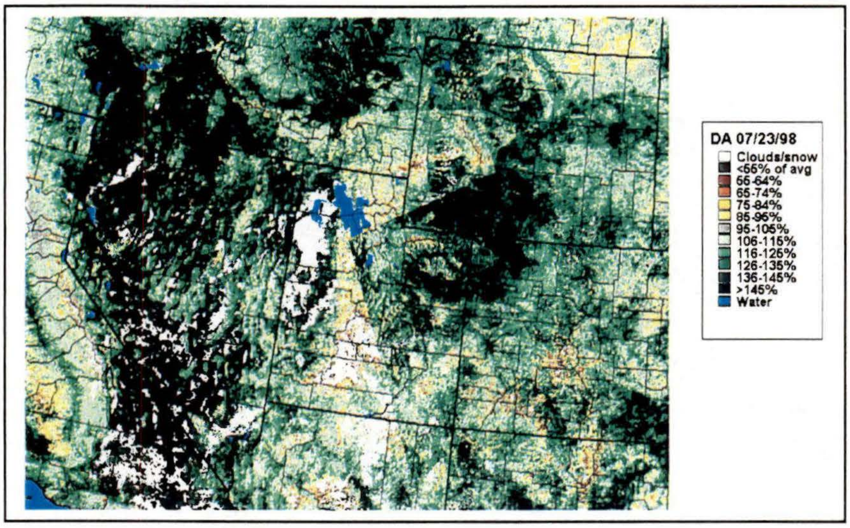


Figure 4. Departure from average - 7/23/98.

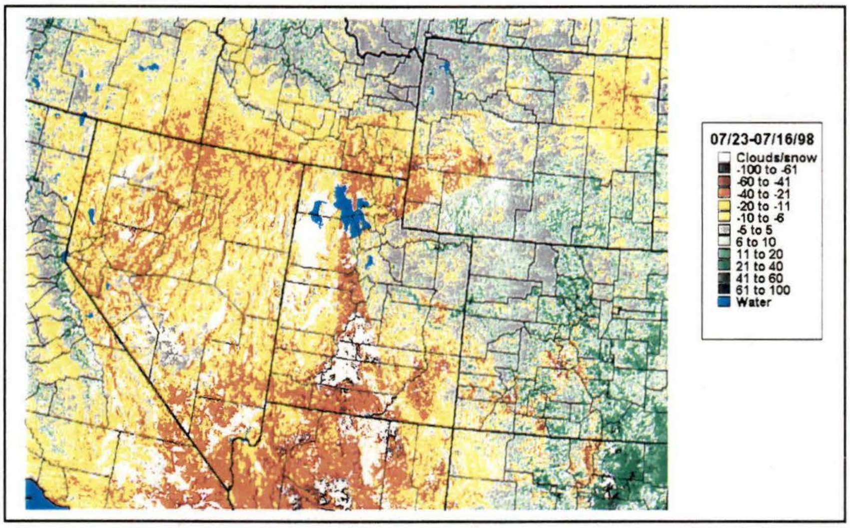


Figure 5. Difference in Relative Greenness - 7/16 to 7/23/98.

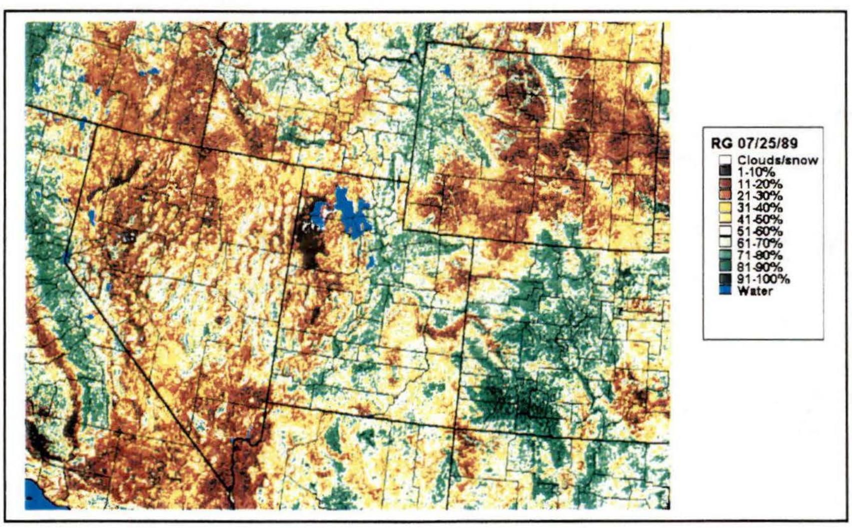


Figure 6. Relative Greenness - 7/25/89.

Reaching Very high Relative Greenness values and maintaining higher than average values for much of the greenup period indicates a greater than average load of vegetation has grown. When cured, this extra vegetation can result in greater than normal fine fuel loads.

By subtracting the Relative Greenness map data for 07/16/98 (Figure 2) from the map data for 07/23/98 (Figure 3), a difference map can be created that illustrates the change over a one-week period (Figure 5). As shown in this figure, all zones are curing rapidly. Areas that have cured over the past week are shown in yellow through brown tones. These areas are approaching seasonal values.

Review of historical greenness data from the same time period in 1989 (Figure 6), an active fire season, shows far more extensive curing during that year than during the current year.

Lower elevation basins throughout the geographic area are currently showing low greenness values, indicating cured or curing vegetation. Upper elevation, forested areas are rapidly approaching normal levels for the time of year. Curing should be expected to continue even with the onset of monsoon moisture due to normal progression of plant physiology. Once cured, much of the Great Basin will have a higher load of fine fuels than in average years.

Comparison of Current and Historical Weather and Fire Activity

Weather:

Ocean temperatures in the Equatorial Pacific rapidly returned to more normal levels during the spring signaling an end to the current El Nino. As a result, the strong jet stream that pushed storms across the southern United States during the winter shifted north and weakened. Pacific storms were directed more toward the Pacific Northwest and had a tendency to stall over the Great Basin and northern Rocky Mountains. Spring weather throughout much of the Great Basin became cooler and wetter than normal. The surplus in moisture resulted in a heavier than usual grass crop on the rangelands. Cooler temperatures delayed snowmelt in the mountains and thus greenup in the higher elevations. Tables (1-3) below illustrate the April through June precipitation patterns in Idaho/western Wyoming, Utah and Nevada.

Except for extreme eastern Idaho (Salmon to Malad), Idaho and western Wyoming experienced a drier than normal April. May turned very wet with rainfall amounts of over 7 inches on the Boise and Payette National Forests. McCall received 7.25 inches and Idaho City 7.31 inches setting new rainfall records for the month. Boise's 4.40 inches also set a new May rainfall record. Wet conditions continued through June. McCall had another 4.62 inches, which brought their surplus rainfall for the two months to over 7.5 inches. Temperatures were generally cooler than seasonal for April, May and June. The only warm spell occurred during the last week of April and the first week of May when temperatures soared into the 70s and 80s, or 10-14° F above normal.

Table 1. Idaho/Wyoming precipitation and departure from normal (April through June).

LOCATION	April	Dep	May	Dep	June	Dep
McCall	1.79	-0.18	7.25	5.17	4.62	2.55
Idaho City	1.31	-0.52	7.31	5.82	2.35	0.94
Salmon	2.10	1.31	1.40	0.00	1.71	0.23
Boise	0.81	-0.43	4.40	3.32	1.21	0.40
Idaho Falls	2.56	1.45	3.11	1.73	1.69	0.45
Malad	1.35	0.13	4.26	2.53	1.67	0.20
Jackson, WY	0.62	-0.55	1.51	0.32	2.59	0.86

April and May were drier than usual in Utah except for the southwest corner around Zion NP. Central and eastern Utah was especially dry. Vernal received only .23 of an inch and Richfield .58 of an inch. June turned wet though, especially from Richfield northward. Salt Lake City recorded nearly 4 inches for the month, about 3 inches above normal. The southern part of the state was generally dry. Temperatures were near to a little cooler than normal. June was especially cool in Salt Lake City averaging 6.5° F below normal.

Table 2. Utah precipitation and departure from normal (April through June).

LOCATION	April	Dep	May	Dep	June	Dep
Salt Lake City	2.00	-0.12	1.04	-0.76	3.84	2.91
Vernal	0.13	-0.68	0.10	-0.78	1.24	0.45
Richfield	0.47	-0.32	0.11	-0.73	1.57	0.99
Monticello	0.51	-0.34	0.64	-0.28	0.35	-0.22
Zion NP	2.62	1.47	1.13	0.29	0.83	0.35

The northern part of Nevada was also wetter than normal between April and June. Reno recorded above normal rainfall all three months. Winnemucca with 3.57 inches and Elko with 1.91 inches were exceptionally wet in May. Meanwhile, the southern part of the state was dry. Las Vegas received only .27 of an inch in April and May and only .03 of an inch in June, less than 50% of normal for the three months. Temperatures were cooler than usual all three months, averaging as much as 5° F below normal.

Table 3. Nevada precipitation and departure from normal (April through June).

LOCATION	April	Dep	May	Dep	June	Dep
Reno	0.66	0.22	0.82	0.13	1.39	0.93
Winnemucca	1.44	0.60	3.57	2.74	0.90	0.04
Elko	0.29	-0.53	1.91	0.91	0.89	-0.02
Ely	1.26	0.26	0.66	-0.49	1.94	1.06
Las Vegas	0.14	-0.07	0.13	-0.15	0.03	-0.09

Ocean temperatures in the central equatorial Pacific became cooler than normal in July indicating the initial stage of a La Nina event (Figure 7). La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures in the equatorial Pacific.

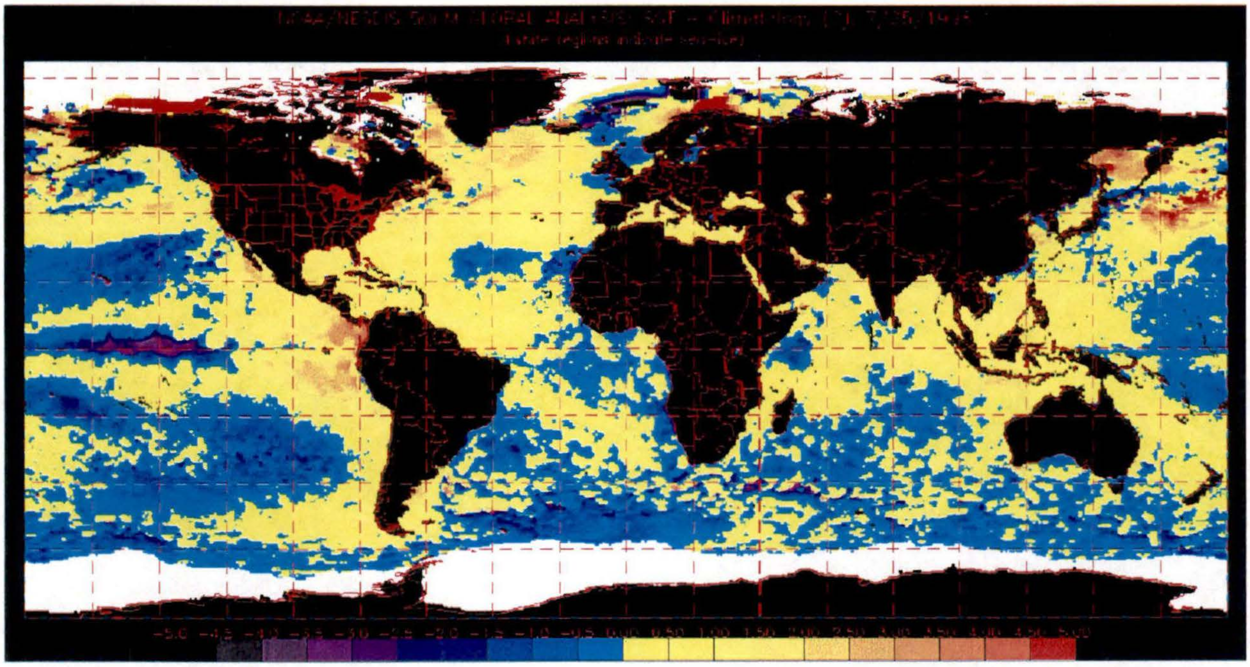


Figure 7. Ocean temperatures July 25, 1998 compared to normal

La Ninas often follow El Ninos, but not always. In the last 50 years, there have only been 10 La Nina cases, the most recent in 1988-89. Global climate variations in La Nina years tend to be opposite of those characteristic of El Nino with weaker wintertime jet streams over the central and eastern Pacific, and enhanced monsoons over Australia/Southeast Asia, South/Central America and Africa.

Even though there was a marked change in the Great Basin's weather in July, this shift was unrelated to the transition from El Nino to La Nina. Strong high pressure aloft, which had persisted over Texas and the Southeastern States, shifted into the Great Basin in July. The weather turned hot and dry through the middle of the month. Monsoon moisture finally shifted northward bringing scattered thundershowers and locally heavy rain to much of Nevada and Utah. A band of above normal rainfall extended from southern/central Nevada into Utah. Southern Idaho, northern Nevada and western Wyoming remained dry (Figure 8).

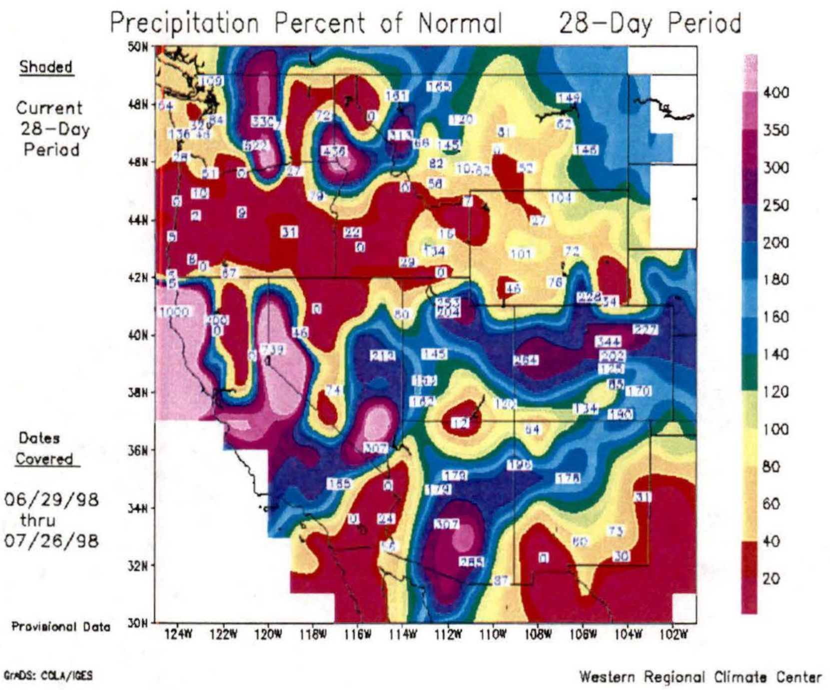


Figure 8. Percent of normal precipitation June 29 through July 26, 1998

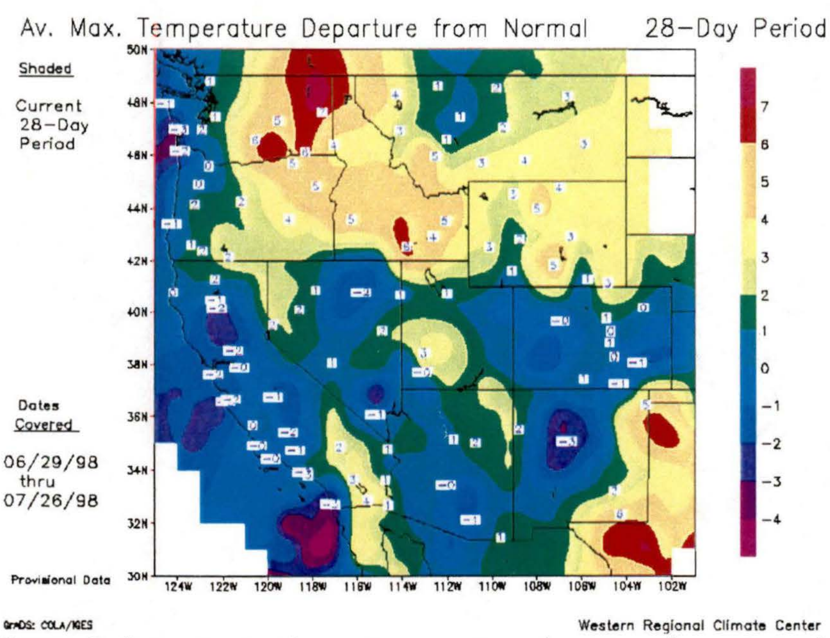


Figure 9. Average maximum temperature departure from normal

July temperatures averaged 4-6° F hotter than normal across central and southern Idaho and 1-3° F above normal in Nevada and Utah. (Figure 9).

July's hot, dry weather rapidly cured grasses in the lower elevations and lowered fuel moisture readings to more normal values. Fuel moisture values recovered somewhat in Utah and Nevada the latter half of the month due to showers associated with the monsoon.

Fire Ignitions:

Fire history records for the period of 1980 through 1997 for the federal agencies of the Great Basin Geographic Area were analyzed to determine fire frequency and magnitude. Federal agencies include the Bureau of Land Management, Forest Service, Bureau of Indian Affairs, National Park Service and Fish and Wildlife Service. The fire load of other agencies was not analyzed.

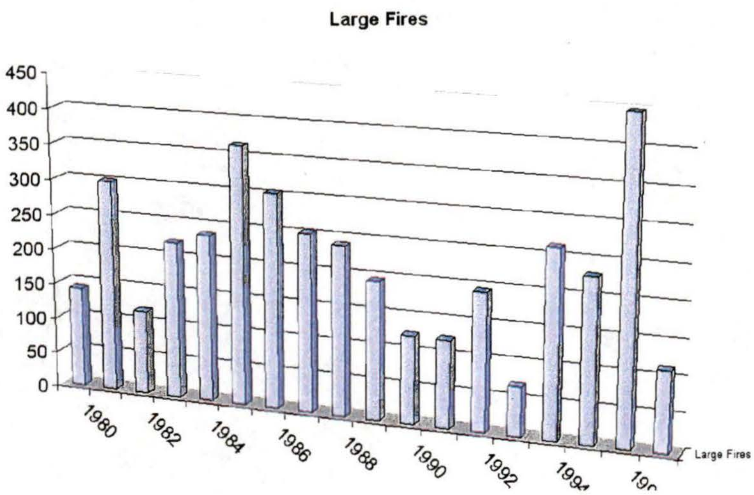


Figure 10. Great Basin Large Fires

Particular attention was paid to fires, 100 acres and larger in size (size class D and larger). Fires smaller than 100 acres can generally be handled with local resources and don't generally require large mobilization from out of the local area.

Figure 10 displays the number of size class D and larger fires for the period of 1980 through 1997 for all federal land management agencies in the Great Basin. Note that the greatest number of large fires occurred in 1996 and the second greatest number in 1985. The lowest number of large fires occurred in 1993.

The available data did not distinguish between forest or range fires. This distinction is important (Figure 11) because forest and range fires differ in location within the area and the two types of fires also have different durations and frequently require differing levels of resource comittment. We assumed that fires on national forest lands are forest fires and fires for remaining federal lands are range fires. Although this may not be true in all cases an argument can be made for using this assumption for an entire geographic area. Fires gain size rapidly in range ecosystems and they also tend to occur earlier in the year (lower elevations).

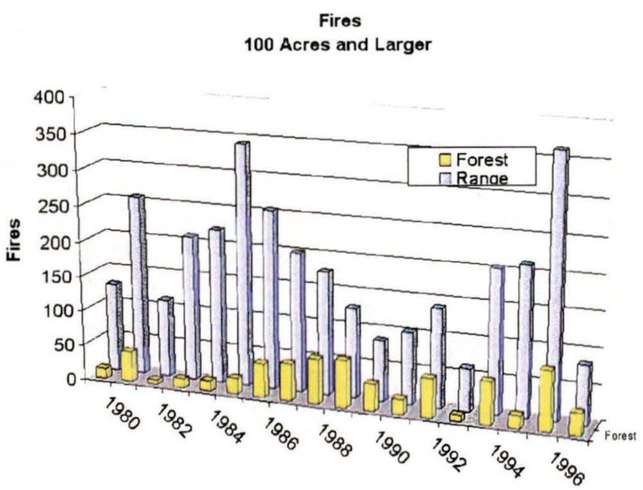


Figure 11. Great Basin Forest and Range Fires

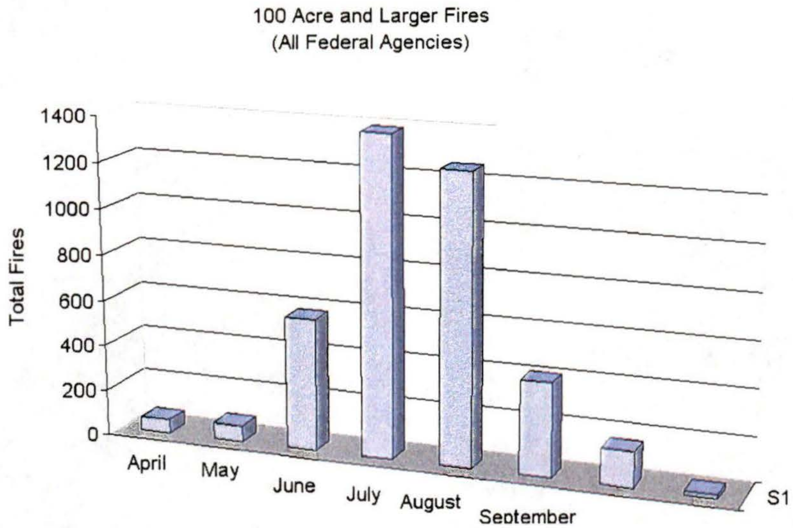


Figure 12. Large Fire Occurrence by Month

In general the fire workload starts in late May and early June, climbs to a peak in July, declines slightly in August, and is all but over by late September (Figure 12). The large fires (100 acres and larger) tend to occur in July and August but occur much less frequently in June and September.

A worst case scenario is based on the worst August and later fire season (since 1980) which is 1996 when close to 250 large fires occurred in August, September, and October. The best case would be 1989 or 1993 where less than 50 large fires occurred in the late summer and fall. Figure 13 displays the total large fire count for August and later by year.

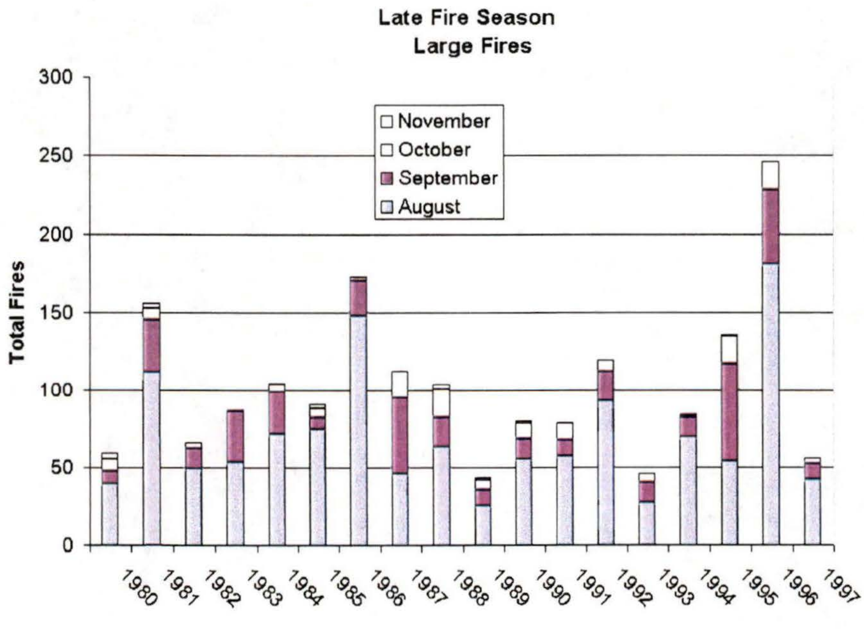


Figure 13. Late Season Large Fires

For the forested lands, August was the most active month in nine of the 18 years (1980-1997). July was the most active in five years, September in two years and June and October one year each. For the rangelands, August was the most active month in nine years, July in eight years with June the most active in only one year. The peak of activity occurred in both forest and range lands in the same month 11 times in the 18 years with seven of those years being August and four years being July.

Since fire load is directly related to fire weather it is important to analyze historic weather records to see how similar weather patterns have affected fire load. Climatologically, the years 1988 and 1989 appear to be similar to the forecast pattern. As a result the fire records for 1988 and 1989 were used to formulate a projection for a worst case scenario.

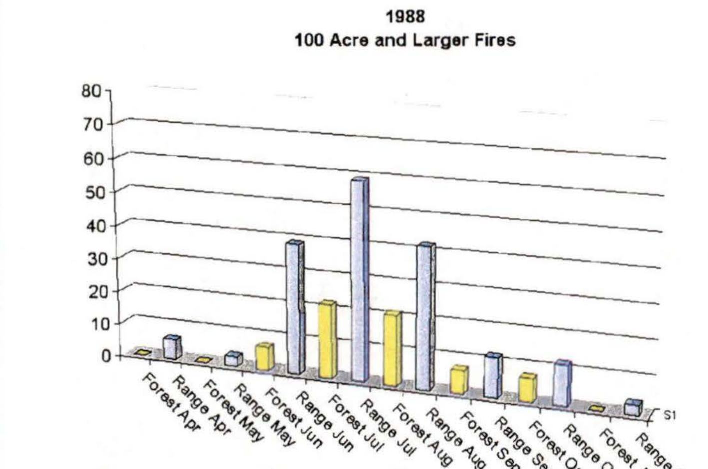


Figure 14. 1988 Large Fires

The 1988 fire season was moderately active with a total of 240, 100 acre and larger fires (Figure 14). The first large fires were recorded on rangelands in April and in June for the forested lands. The peak month for both forest and range lands was July with August being the second most active. Large fires continued to occur into October but at a much lower frequency.

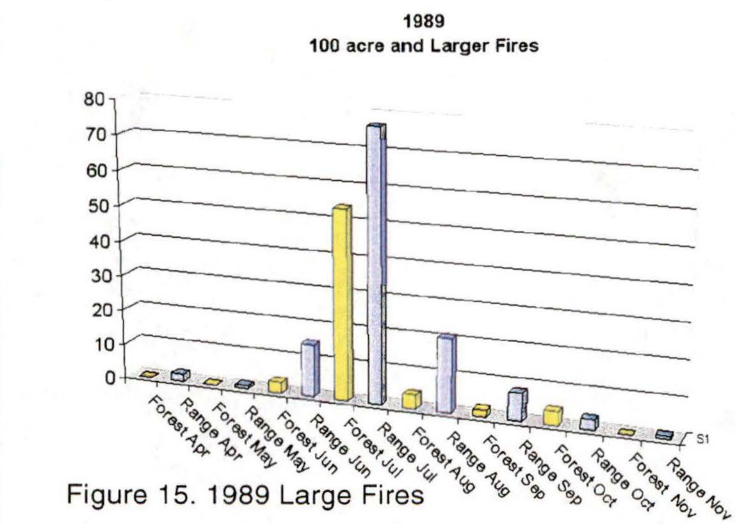


Figure 15. 1989 Large Fires

Interestingly, these years were not exceptional years for either a high or low number of fires but were near average. However, for the forested ecosystems these were the second and third highest large fire frequency years based on the data analyzed. If the weather continues to follow the track that was set in 1988 and 1989 (Figure 15), expect an average year in 1998 for range fires but an above average year for forest fires.

Fire Danger Indicators:

The Great Basin Geographic Area was divided into eight fire potential evaluation zones. Within each zone representative stations were selected based upon historic data, discussions with area managers and fire weather forecasters, representative elevations and currency (Figure 16).

All stations were processed using a representative fuel model to calculate the National Fire Danger Rating System (NFDRS) index values for the area. For NFDRS Fuel Model G 1000 hour fuel moistures, Energy Release Component, and herbaceous fuel moistures were monitored. Energy Release Component, woody and herbaceous fuel moistures were evaluated for NFDRS Fuel Models T and F. Where fire danger conditions were found to be comparable across fire

potential evaluation zones, representative graphs are shown. The graphs on the following pages show this year's average values and compare it to historic maximum, minimum, average, and one selected extreme year.

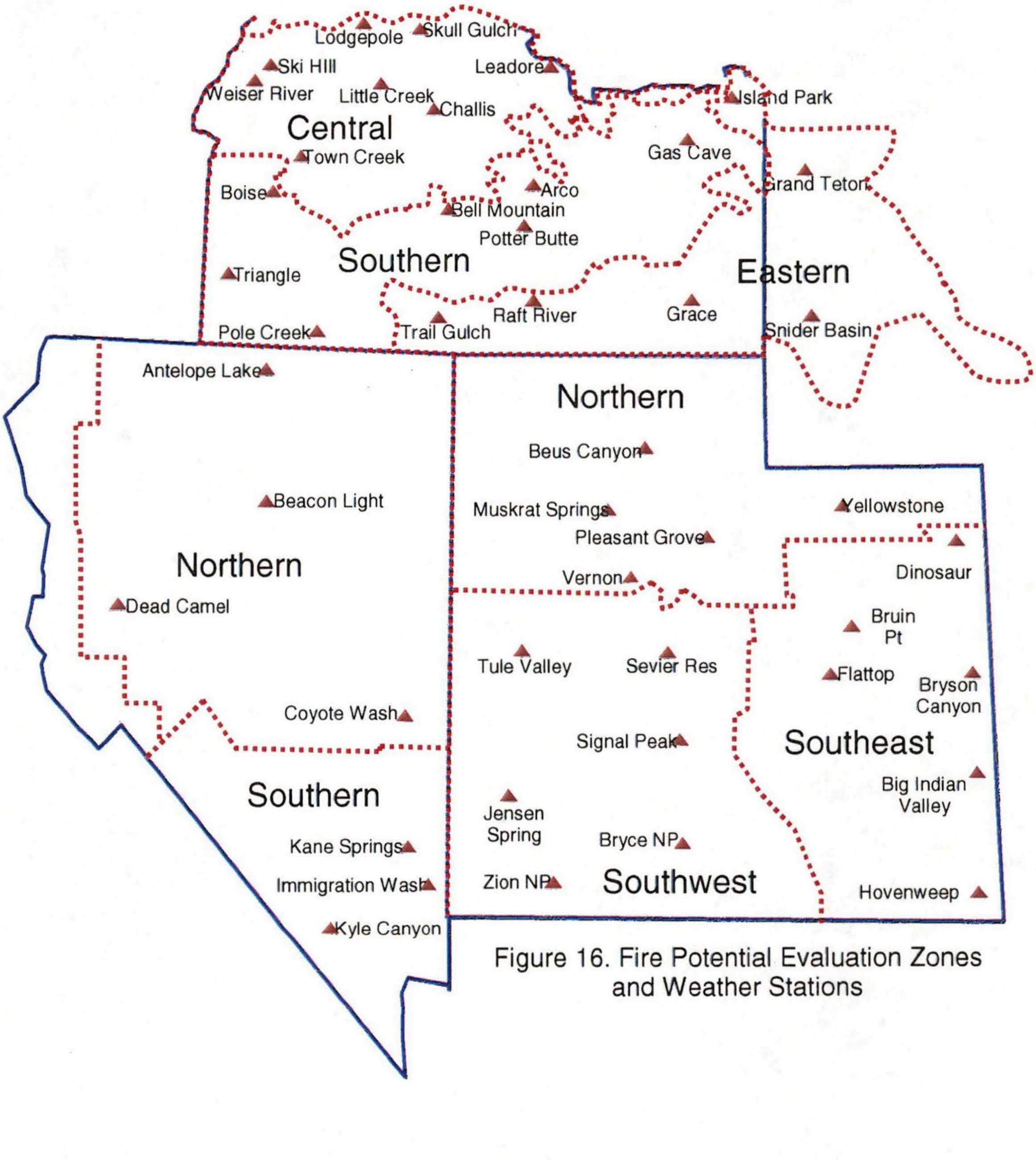
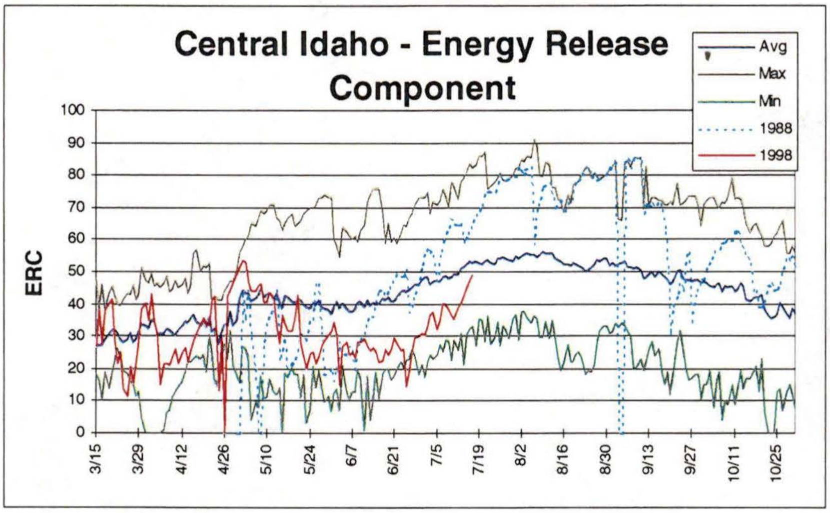
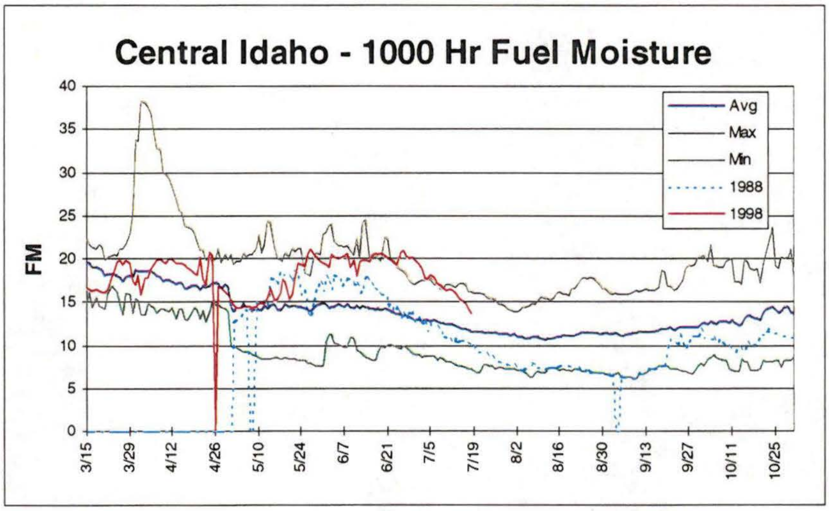


Figure 16. Fire Potential Evaluation Zones and Weather Stations

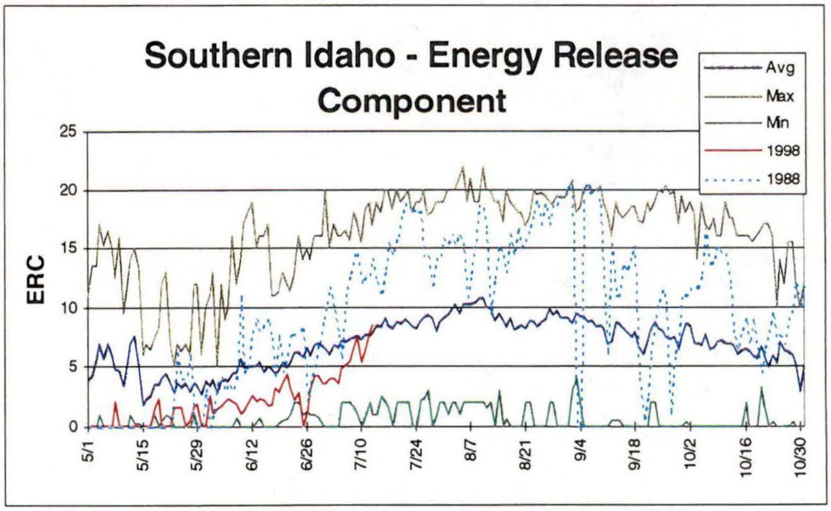
Central Idaho Zone - NFDRS Fuel Model G
Southern Idaho Zone - NFDRS Fuel Model T



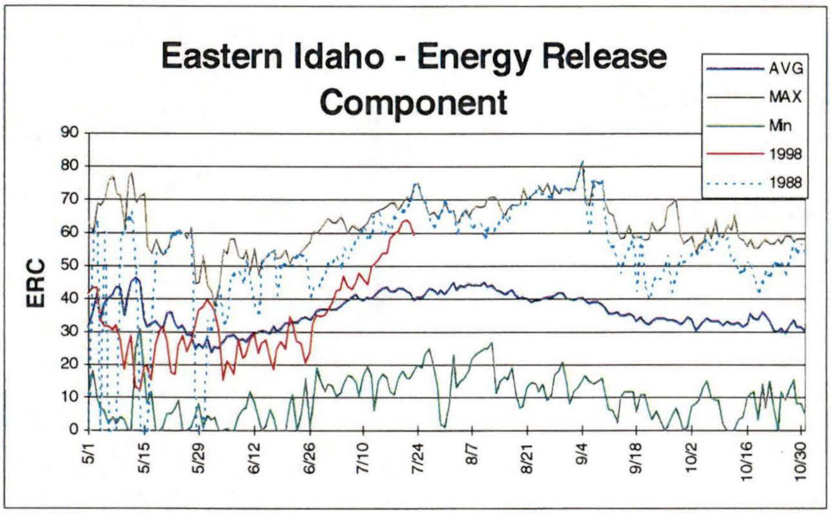
For the above listed zones the Energy Release Component was below normal until the high pressure system brought warmer weather in to the area in early July.



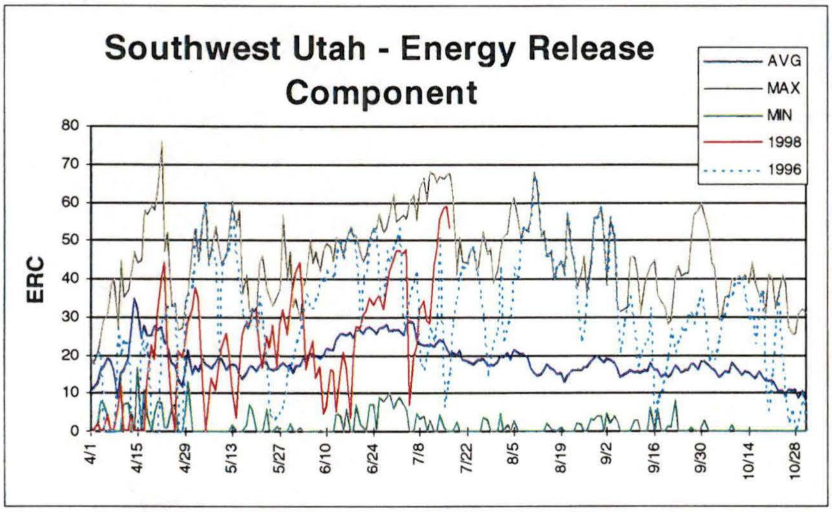
The 1000-hour, woody, and herbaceous fuel moistures have been at the historic maximum although they are now trending toward normal. These trends are approximately two weeks behind the historic average trend.



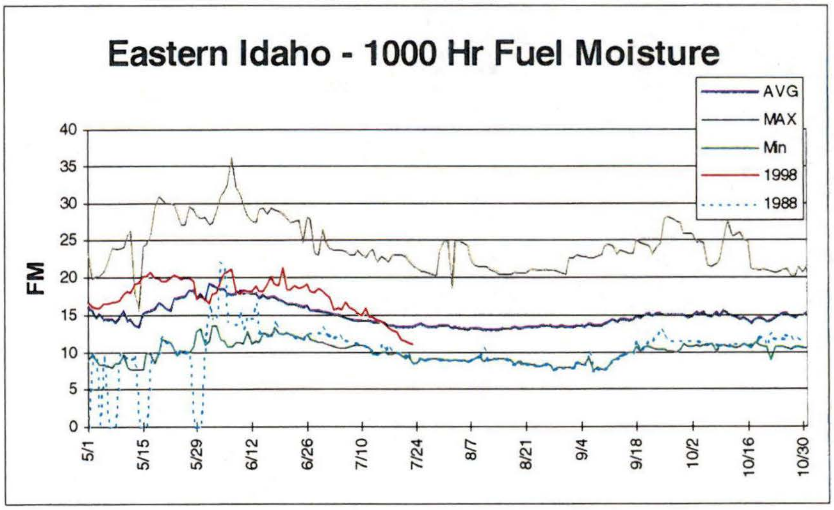
Eastern Idaho Zone - NFDRS Fuel Model G
Southwestern Utah Zone - NFDRS Fuel Model F
Northern Utah Zone - NFDRS Fuel Model T



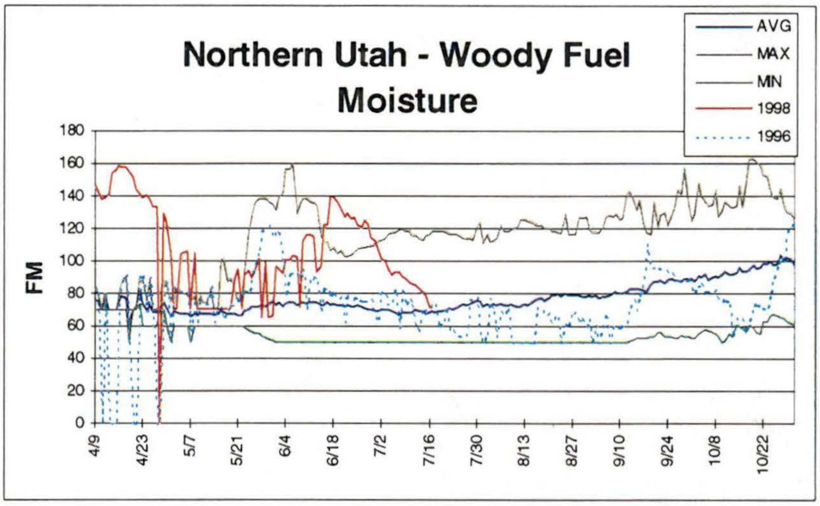
In all of these zones the Energy Release Components were tracking well above average and at times nearly reaching the historic maximums.



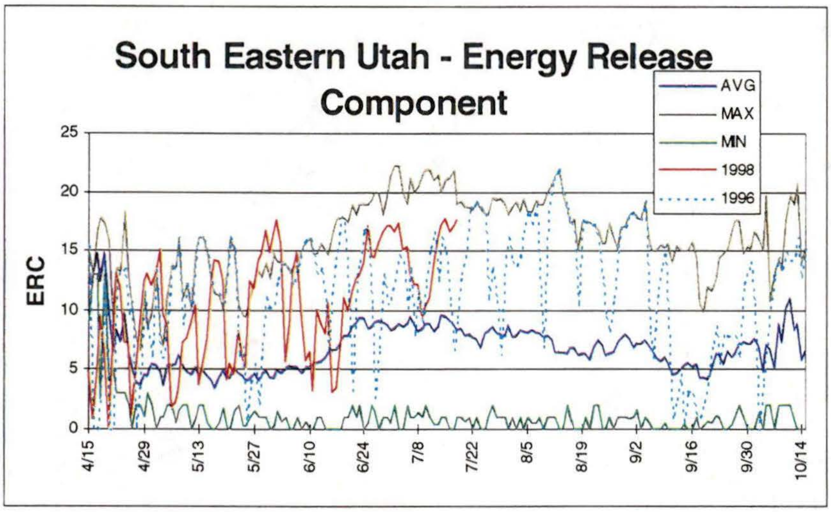
The 1000 hour and herbaceous fuel moisture has been slightly above or at normal for Eastern Idaho. The woody fuel moisture for the Southwestern Utah zone was tracking very similarly although it is currently below average and at 1996 values.



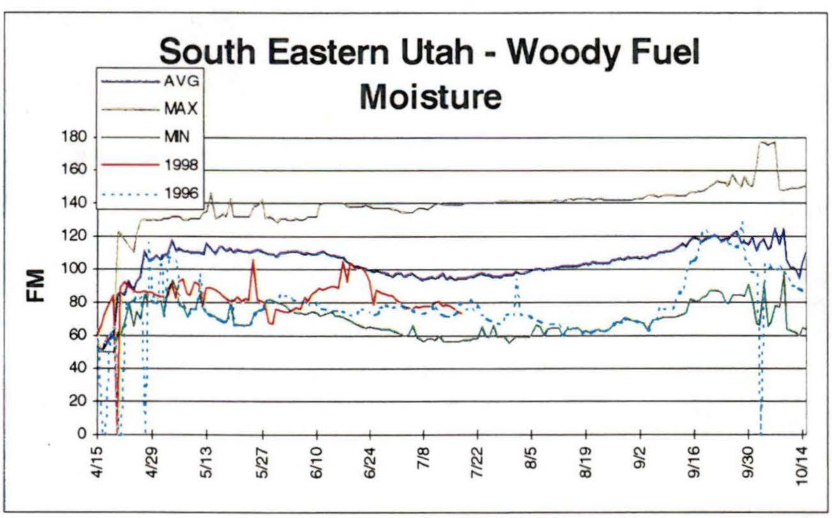
The woody and herbaceous fuel moisture for the Northern Utah zone was well above normal until early July when it began trending toward seasonal averages.



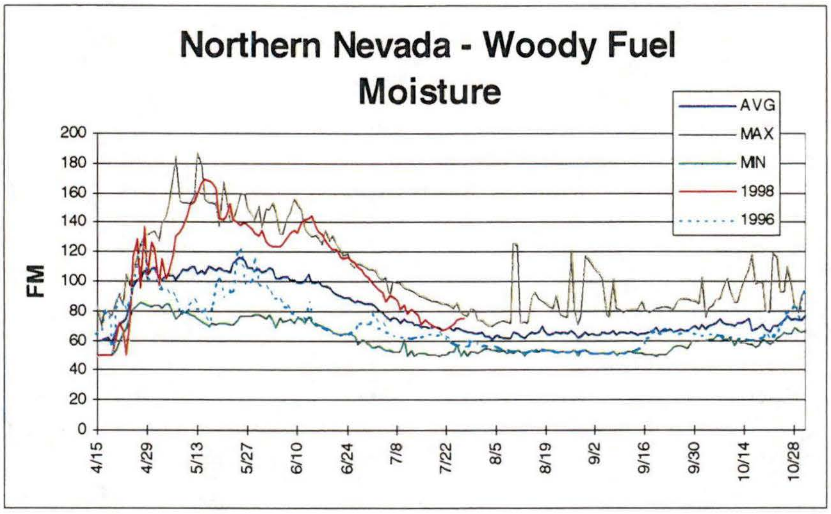
South Eastern Utah Zone - Fuel Model T



The Energy Release Component has exceeded the 1996 index value. These indices have moderated due to moisture in the area. The herbaceous fuel moisture was at average whereas the woody fuel moisture has been below average and at 1996 readings for most of the season.

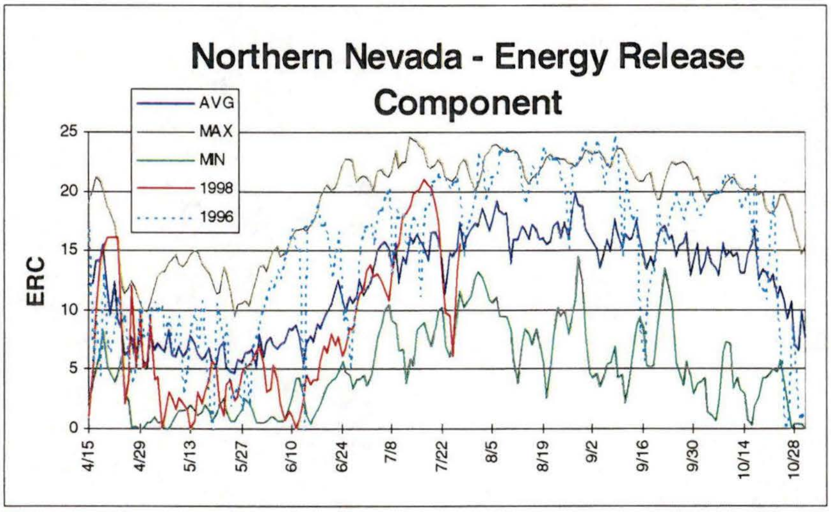


Northern Nevada Zone - Fuel Model T



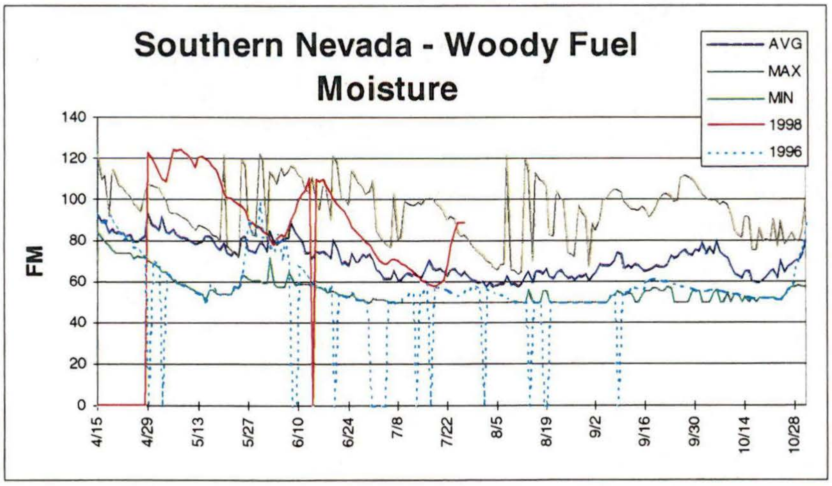
The woody and herbaceous fuel moisture for this area has been above average and at historic maximum and it has been trending downward in what seems to be a normal trend.

These data were evaluated using relatively short data sets therefore may not be as reliable.



The Energy Release Component was at 1996 high values in mid July although those values have moderated.

Southern Nevada Zone - Fuel Model T



The woody fuel moistures were at maximums for this time but have cured to average, just slightly behind the historic trends. The herbaceous fuel moisture has been below average since mid June and is now at average. As seen above, the Energy Release Component has reached historic maximums but it is now average or slightly below. Again a short data set was analyzed.

Fuels and Fire Behavior:

The Great Basin can be divided into fuels zones which generally follow elevation. Western grasslands, sage and scruboak dominate lower elevation areas. NFDRS Fuel Models A, F, and T are represented here. Pinyon-juniper, oakbrush and other deciduous shrubs occupy mid-elevations. NFDRS Fuel Models F and P are represented here. Coniferous forests of long needle pines, short needle pines and firs dominate upper elevations. NFDRS Fuel Models C and G are represented in those areas.

Fine Fuels:

Fine fuel loadings throughout the Great Basin are reported to be nearly four times what is considered normal. The relatively cool, moist spring and summer last year provided a longer period of active growth for annuals. This was followed by a winter of below normal snow pack in the lower elevations, which reduced compaction, and decomposition of the cured fuels.

This year's above normal April - June spring precipitation resulted in greater seed germination and active growing period in both annual and perennial vegetation. The effect of this was to produce a dense, high continuous fine fuel bed. Even in areas where normally mineral soil spacing was often great enough to retard fire spread, there is a fine fuel bed that would carry fire.

Cheatgrass, Fire Behavior Prediction System (FBPS) Fuel Model 1, was measured at 22-36" and was reported as "difficult to walk through." Perennial grasses are reported to range up to 36-52" high and are best represented by FBPS fuel model 3.

Prior to curing of the grasses, fire was reported capable of moving through totally green grass, being carried by last year's dead fuels. In cured fuels rates of spread up to 400 ch/hr and flame lengths of 8 - 12' can be expected. This fine fuel bed will continue to represent a hazard even during a relatively moist summer as it can dry quickly.

Shrubs/Pinyon - Juniper:

Sage/grass types have displayed a relatively dense grass understory and the shrubs have full crowns. Pinyon-juniper shows the same trend and should be considered more susceptible to surface fire spread than is normal. Crown density in these vegetation types is greater and therefore crown fire spread is more likely. Torching crowns will have a higher probability of producing spot fires due to the greater fine fuel loads.

Live woody and herbaceous fuel moistures have trended at or slightly above historical averages, which may be contributing to the lack of large fires within the Great Basin to date. Live herbaceous moistures dropped quickly during a period of record high temperatures and low relative humidities the first part of July. This was being reflected in the observed fire behavior which has included torching and short range spotting. Monsoonal moisture retarded that trend the third week of July except for parts of Nevada and western Idaho. It was also noted that there was some spring frost kill in the oakbrush, leaving a dead fine fuel component in the crowns which may lead to higher intensity fires in some areas.

Coniferous Forest:

Coniferous forests in the upper elevation held the above average snow pack much longer than usual due to the cool moist spring and early summer. In fact, in late July, there is still snow present in areas above 9600'. Live woody and herbaceous fuel moistures are still quite high and vegetation is at or near full turgor. Large woody fuel moistures are at or above historical normals.

Calculated 1000-hour fuel moistures are 11-15% for south, central, and northeastern Utah. The 1000-hour fuel moistures are 16 - 20% for the Uintas. The driest areas are Moab, western Utah, southern Idaho, and the Snake River Breaks at 6 - 10%. Large fuel consumption was observed to be 100% on south facing slopes in southern Idaho.

Beetle killed lodgepole exists in dense stands in selected upper elevations. Much of what was observed is still standing and retaining needles. With sustained drying, upper elevation forests can reach fuel moisture levels conducive to extreme fire behavior with or without wind.

In summary, the low-level grass and shrub lands always have the potential for large fire growth until fall weather ends the season. Upper elevation forests are lagging behind in drying. There is a good probability that the window of high flammability will be narrow this year, or may not open at all.

Expected Duration and Situation-Ending Criteria

Estimates of the expected duration of wildland fire activity and probability of the advance of weather and fuel moisture criteria that could end the 1998 fire situation were developed based a review of daily precipitation probabilities and an analysis of historic weather records to determine season-ending events. The following sections describe these reviews and provide the basis for the later discussion regarding future scenarios.

Daily Precipitation Probabilities:

The effects of La Nina on the Great Basin's weather during the remainder of the summer should be small as it is still developing. The outlook for August favors typical hot and dry conditions for Idaho, most of Nevada and northwest Utah. Weak disturbances, moving into the Pacific Northwest from the Pacific, have the potential to produce dry lightning and/or strong winds on occasion. Although monsoon moisture will continue to invade southern Nevada and Utah, it is expected to be weaker than normal resulting in below normal rainfall. The monsoon in the southern Great Basin normally peaks the first part of August and then gradually diminishes into September (Figures 17,18).

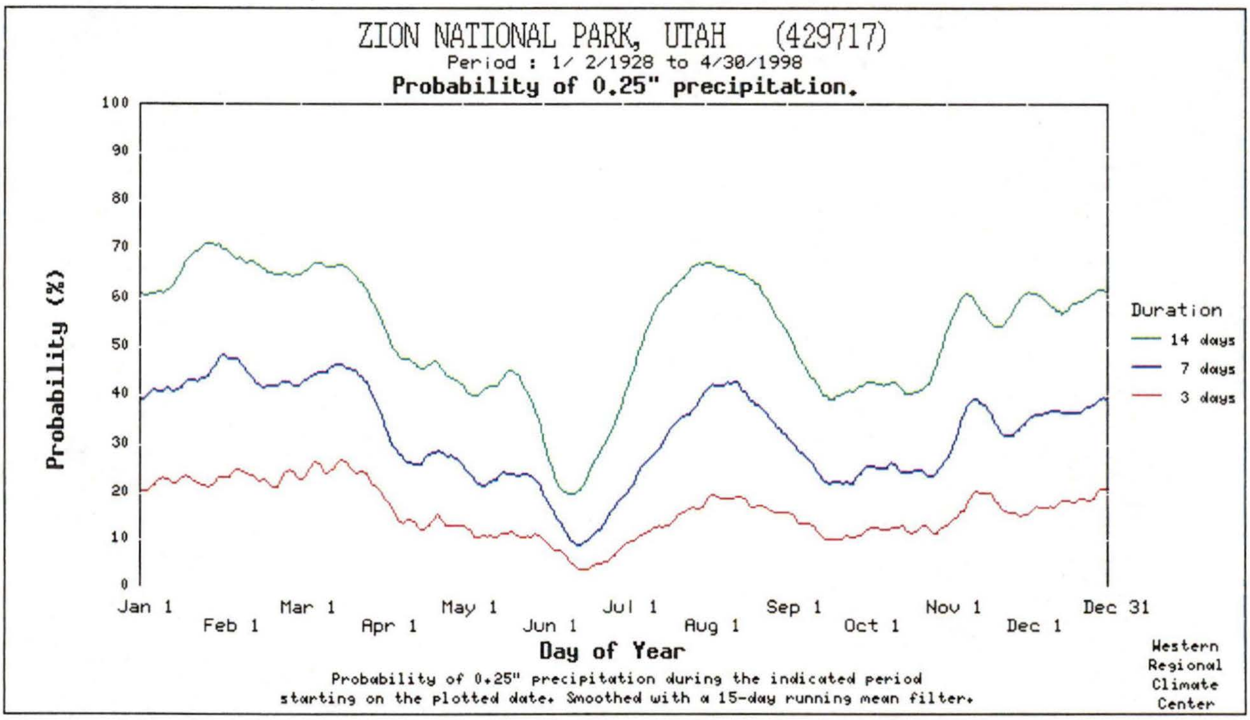


Figure 17. Probability of .25 inches of precipitation at Zion NP over a 3, 7 and14 day period

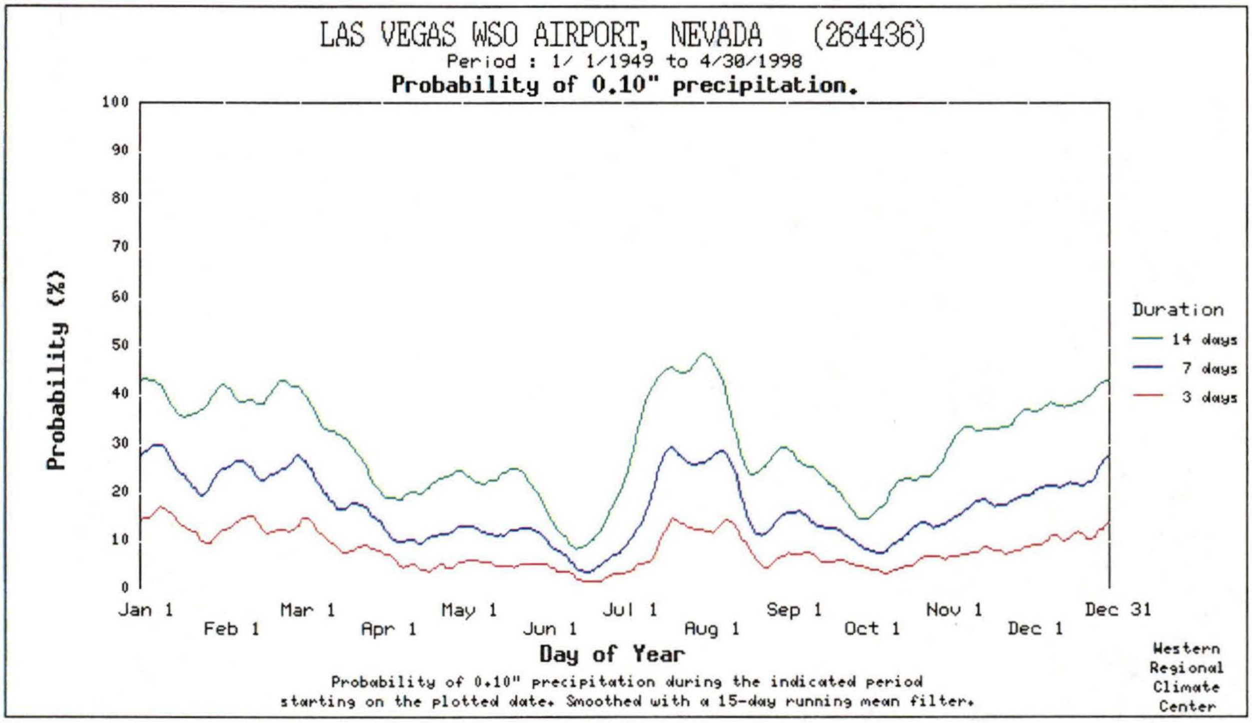


Figure 18. Probability of .10 inch of precipitation at Las Vegas over a 3, 7 and 14 day period.

The outlook for September still favors warmer and drier than normal conditions, especially in southern Nevada and southern Utah. Long-term precipitation probabilities for Idaho indicate a short period of rain is typical the second week of September (Figures 19,20) but this should not be a “season ending” event.

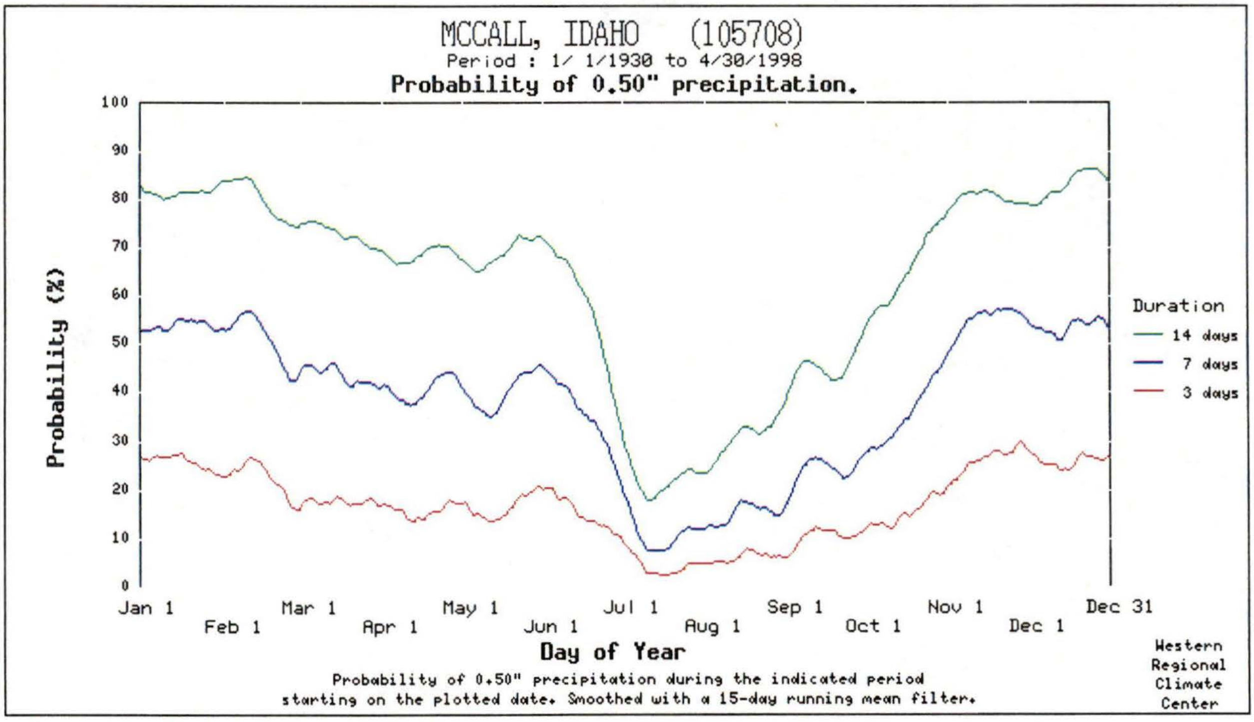


Figure 19. Probability of .50 inches of precipitation at McCall over a 3, 7 and 14 day period.

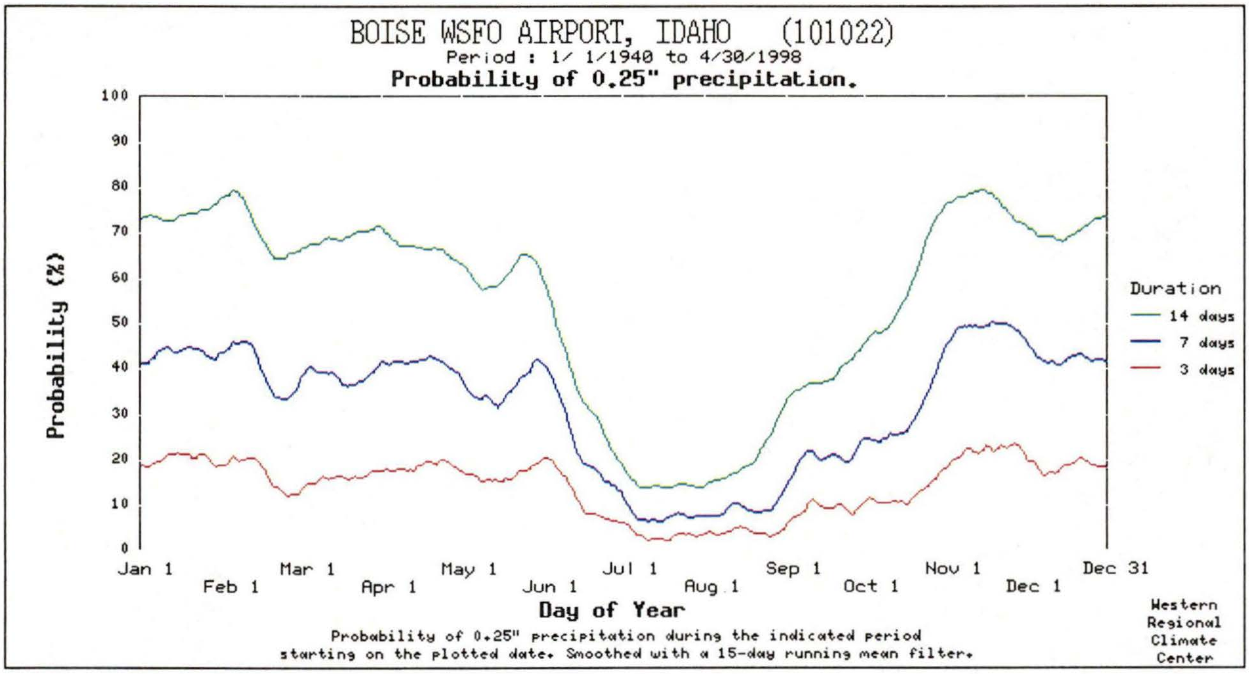


Figure 20. Probability of .25 inches of precipitation at Boise over a 3, 7 and 14 day period

Analysis of Season Ending Events:

Analysis of the history of season ending events can illustrate the probabilities associated with fire season duration. Season ending probabilities were determined for one location in each of three states: Utah, Nevada and Idaho. Two historical weather data sets were selected for each state. Nevada's data spanned nine years due to the relative young age of the remote automated weather stations (RAWS). Utah and Idaho had data sets spanning twenty years. The season ending event was defined as three or more days of precipitation lasting more than six hours within a seven day period. The season ending dates were input into the Rare Event Risk Assessment Process (RERAP) (Wittala and Carlton, 1993) to create three cumulative probability curves. In this application the "Term Event" referred to on the RERAP screens shown below is the season ending event. The graphs below display the event dates and the cumulative probabilities:

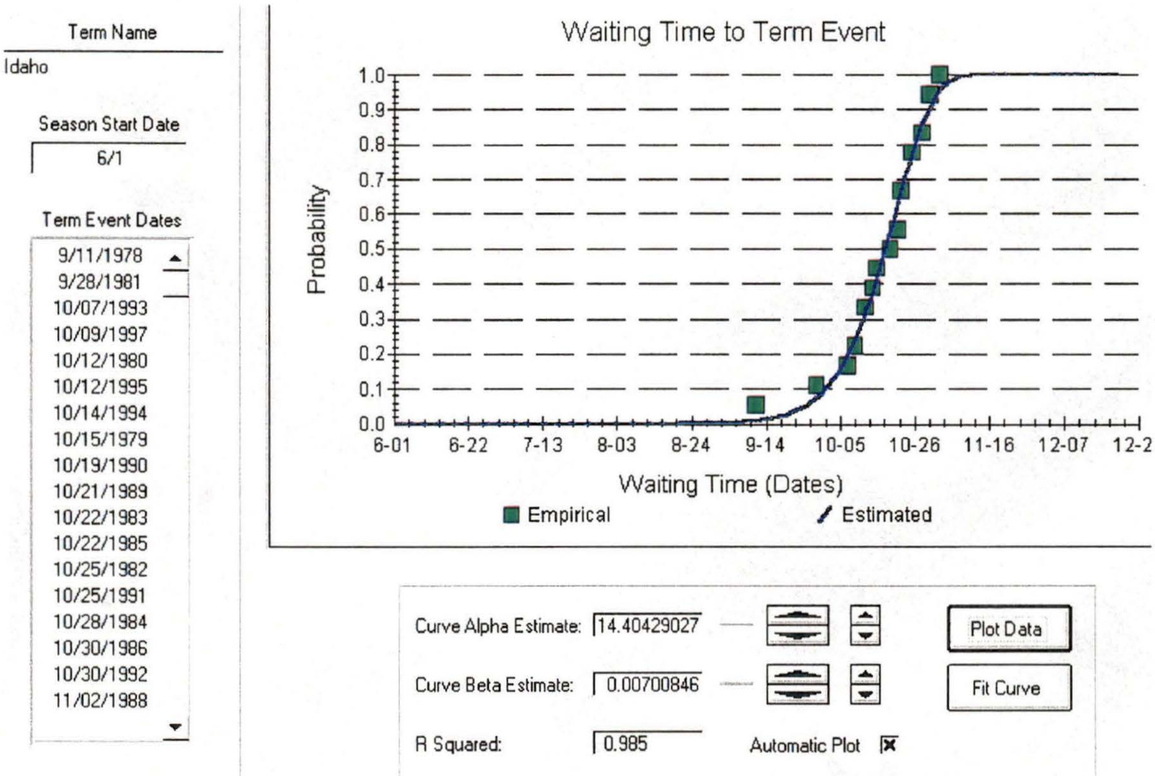


Figure 21. Idaho Season Ending Events.

The range of season ending event dates varies across the Great Basin. In Idaho, the season may end as early as mid-September or last until late October. The probability of a season ending event dramatically increases by mid-October. Season ending event dates for Nevada range from mid-August to mid-November and from late September to early November for Utah. The probability increases gradually for Nevada as the season progresses through the fall while Utah records show a very rapid increase in the likelihood of a season ending event after the first of October.

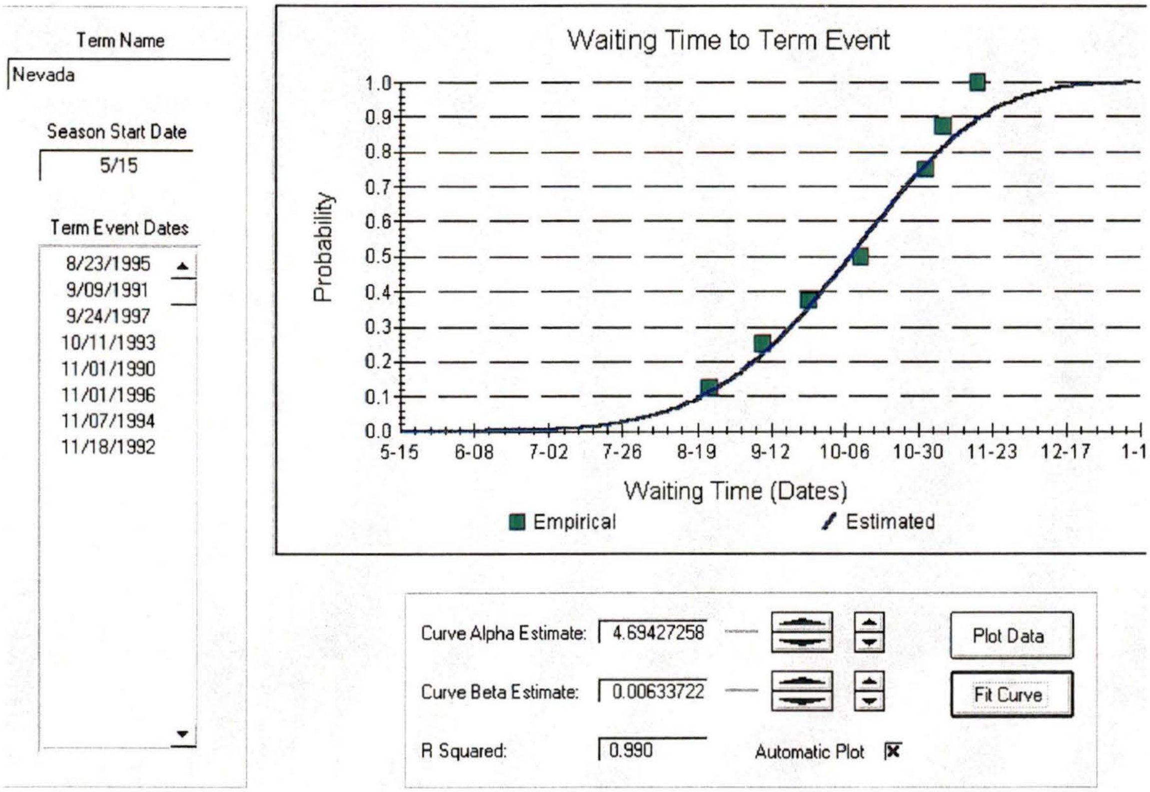


Figure 22. Nevada Season Ending Events

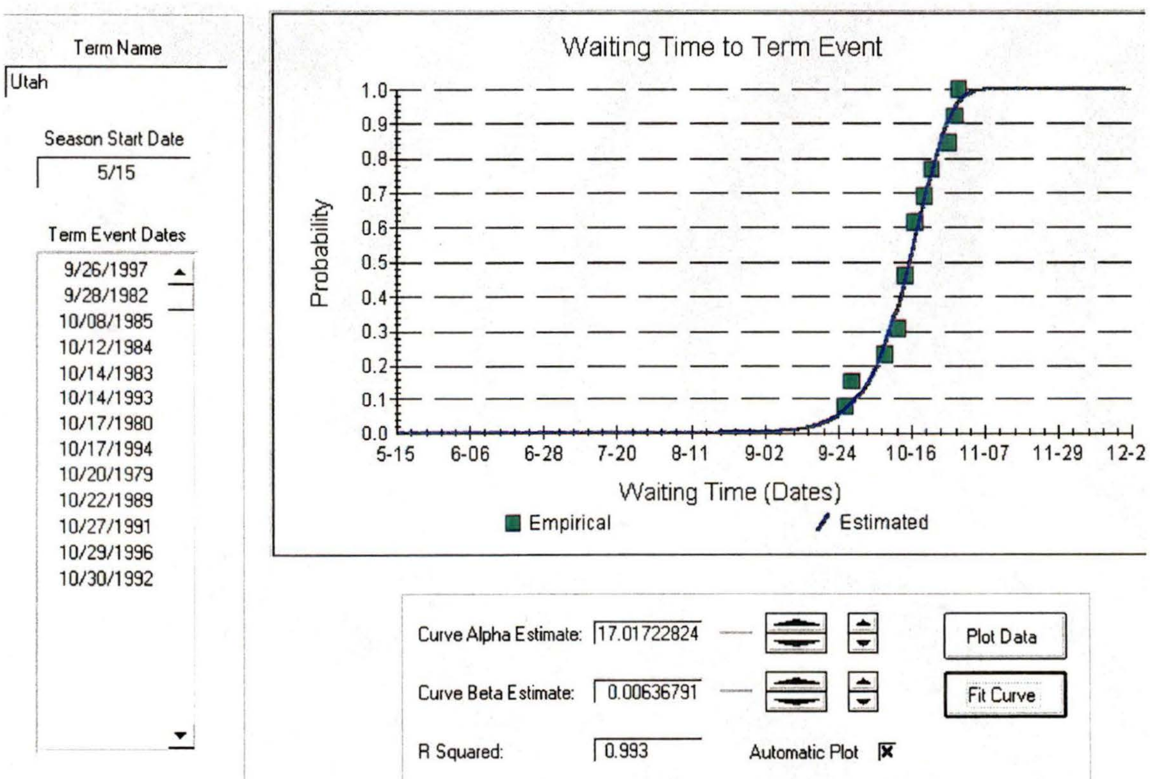


Figure 23. Utah Season Ending Events

Scenarios for the Future:

Projections of three possible scenarios were developed based on review and analysis of historical weather, fire activity information, and comparison with current-year trends and fire activity. The Scenarios include a low level of fire activity (best case scenario), an average level of fire activity (intermediate case situation), and a high level of fire activity (worst case situation).

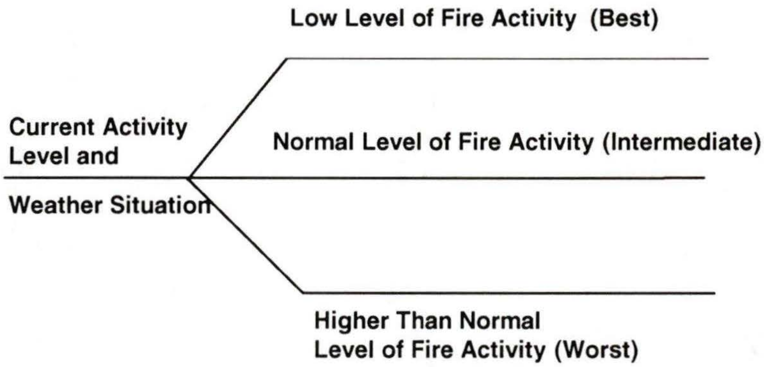


Figure 24. Three Scenarios Considered

The Worst Case Scenario:

The full effect of La Nina may start to be felt this fall and certainly during the winter. The National Center for Environmental Prediction's (NCEP) long range forecast for this La Nina indicates that it could be one of the stronger events, similar to the La Nina in 1988-1989. Fall was extremely dry in the Great Basin in 1988. Little or no rain fell in October and the percentage of normal precipitation was well below 25 percent. It wasn't until the first part of November that significant amounts of rain and snow fell. A similar dry fall this year would represent a worst case scenario, extending the fire season into early November. Temperatures would remain unseasonably warm and relative humidities low through October. The probability of dry cold frontal passages with strong gusty winds would also be enhanced. The chances of the worst case are greater than the best case and less than the intermediate scenarios.

The Intermediate Scenario:

Using a composite of 10 La Nina episodes, October is favored to be only a little drier than normal in the northern Great Basin with the best chance for dry weather in the southern Great Basin (Figure 25). Due to the uncertainties in the strength of La Nina, the composite of 10 La Nina years probably represents a more valid scenario than just looking at the worst case in 1988. In this scenario, October would still be drier and warmer than normal but not as dry and warm as the first scenario. Precipitation would be infrequent and there would be less chance of dry cold frontal passages. **This scenario has the greatest likelihood of occurring**.

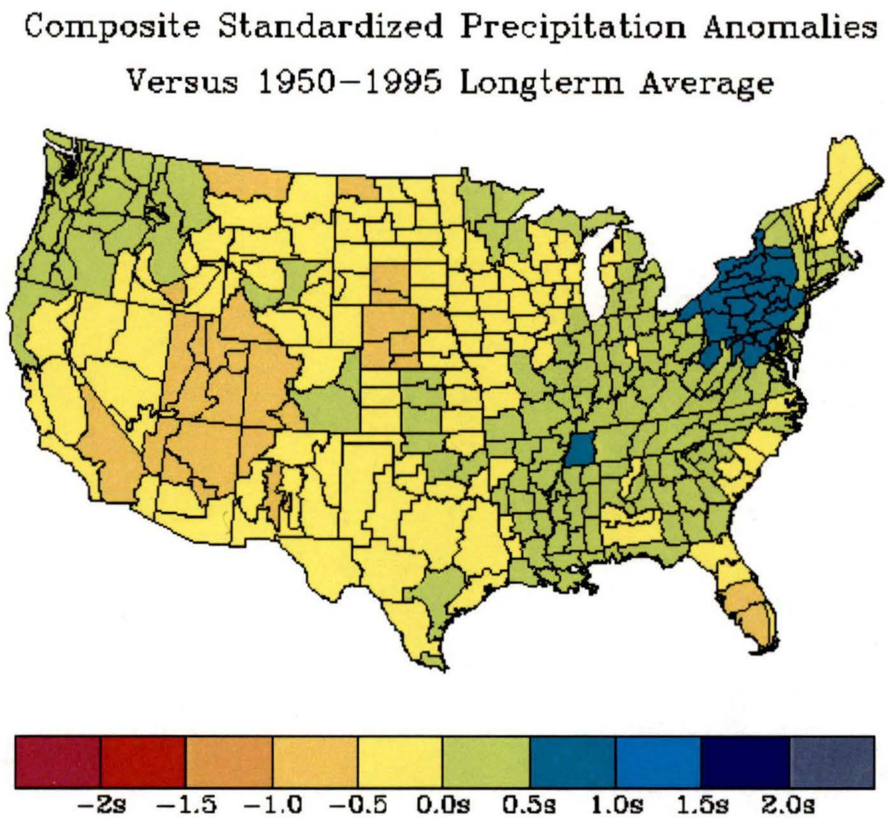


Figure 25. Composite Standardized Precipitation Anomalies for October During La Nina Years

The Best Case Scenario:

A third scenario would be a normal end to the fire season in the Great Basin in late September or early October due to significant rainfall. None of the long range forecast models suggest this. Thus, the probability that this would occur is low.

The longer-range winter forecast is based upon La Nina reaching its greatest strength during the winter months. The southern states, from southern California to Florida, are forecast to be abnormally dry and mild this winter. Meanwhile, wetter and colder than normal weather is forecast for the northern tier of states from Washington, Oregon and northern California to the Great Lakes. Wetter than normal weather should also drop southward into central Nevada and central Utah during the late fall and early winter (Figure 26). Southern Utah and southern Nevada should still remain drier than normal.

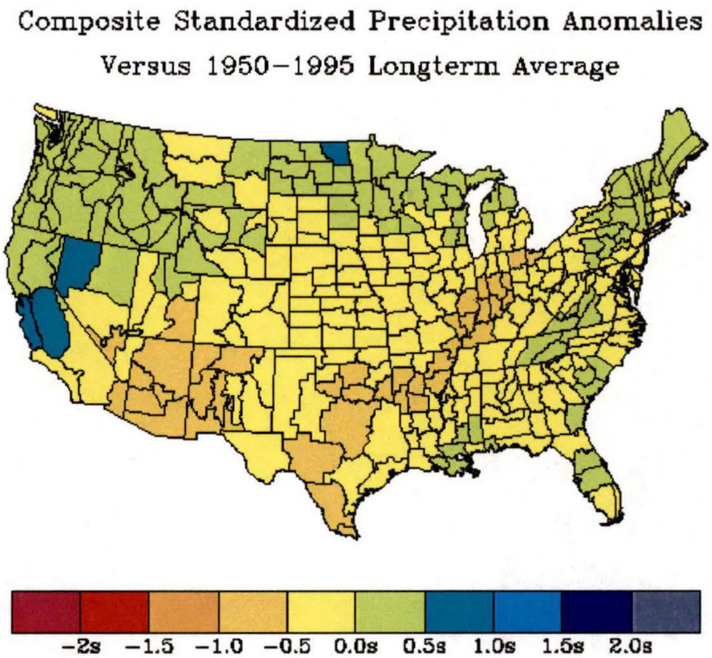


Figure 26. Composite Standardized Precipitation Anomalies for December During La Nina Years

Implications:

The following tables summarize the scenarios and the potential impacts of each one. Table 4 illustrates weather parameters for each of the three scenarios, while Table 5 initial attack capability, resource needs, threats, fire behavior, and fire season duration.

Table 4. Weather related factors for three potential fire activity scenarios in the Great Basin for late summer - early fall 1998.

Scenario	Temperature	Relative Humidity	Precipitation	Probability of Dry Lightning	Dry Cold Front	Probability of Extended Drying Periods	Critical Fuel Moisture Levels
Best	Normal	Normal	Normal	Normal	Infrequent	Low	Low Elevations Only
Intermediate	High	Low	Infrequent	Higher Than Normal	Occasional	Moderate	Lower and Mid-Elevations
Worst	Higher	Low – Poor Nighttime Recovery	Insignificant	Much Higher Than Normal	Frequent	High	All Elevations

Table 5. Regional and national implications of potential fire activity scenarios in the Great Basin for late summer - early fall, 1998.

Scenario	I.A Success	Resource Needs	Resource Availability	Threats to Life and Property	Fire Behavior	Fire Season Duration
Best	High	Local capability	High	Negligible	Normal	Shortest
Intermediate	Initial attack plus occasional large fires	Local plus other within-region resources	High with some shortages	Infrequent	Active	Moderate - Long
Worst	Initial attack plus frequent large fires (many with long-duration)	Local plus regional and national resources	Long duration placing demands on regional and national resources	Occasional	Extreme	Longest, duration will necessitate competition with other geographic areas for resources

Summary

While wildland fire occurrence and severity have not not caused great concern, the potential fire for an active late fire season in the Great Basin exists. The late spring rains have promoted growth of fine fuels in most of the this geographic area. This growth in combination with the significant growth last year, minimally compacted from snow, has resulted in fuel loadings up to three times greater than normal. Greenness images derived from satellite imagery indicate a rapid curing of fine fuels at lower elevations during a hot, dry period in mid-July. National Fire Danger Rating indices show that although some areas of the Basin were at historic maximum for moisture in early July, they are quickly drying to average or below average. In the southern area of the Basin moisture levels have been below normal for most of the season. These indicators along with the prediction for continued dry weather late into the season could indicate that 1998 could portend a high level of late season fire activity in southern Utah and Nevada. The high pressure expected to move over the Basin in early August could dry fuels at all elevations increasing the probability of ignition in all areas. Historic ignition patterns combined with anticipated dry conditions may well portend an extended fire season in the Basin.

By early July, one of the strongest El Nino events this century gave way to the beginning of La Nina. La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures from the date line eastward to the South American coast. Most of the effect of the developing La Nina will likely occur during the coming winter and that is when it should be at its greatest strength. The main effect during the remainder of the summer will be a weakening of the normal monsoon moisture over southern Utah and southern Nevada. However, historical records from strong El Ninos in the past suggest a drier than normal fall is possible delaying the typical end of fire season into late October or early November.

The assessment illuminates the following concerns about the remainder of the fire season in the Great Basin.

- fuel loadings are up to three times greater than normal
- fine fuels at lower elevations have reached their seasonal minimums
- fuels are still drying and minimum levels have yet to be reached in forests
- rapid drying of high elevation fuels could occur and is likely due to La Nina
- sustained fire activity in the Great Basin could potentially persist for four to six weeks longer than normal

As the fire season progresses several indicators may be useful to anticipate the development of a critical fire situation. A set of criteria useful for this purpose is offered in the following list.

- the occurrence of a weaker than normal monsoon through August and into September in Southern Utah and Nevada
- normal September/October moisture absent in northern zones
- fire danger indices (fuel moistures and Energy Release Component) climb steeply
- prolonged drying periods especially if followed by relatively dry lightning

- drying sufficient to promote large fire growth in high elevation forests,
- greenness imagery indicates widespread and/or rapid curing
- ignitions sufficient in number to overwhelm initial attack capability
- fires that spread fast enough to escape initial attack
- low initial attack or reinforcement resource availability,
- large number of backcountry fires with poor accessibility
- adverse long-term weather forecasts.

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